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Draft Cruise Ship Discharge Assessment Report

Section 4: Oily Bilge Water

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Oily bilge water is the mixture of water, oily fluids, lubricants, cleaning fluids, and other similar wastes that accumulate in the lowest part of a vessel from a variety of different sources including the engines (and other parts of the propulsion system), piping, and other mechanical and operational sources. On most cruise ships, bilge water can be managed in one of two ways: (1) retained onboard in a holding tank and discharged later to a reception facility on shore, or (2) treated onboard with an Oily Water Separator (OWS).

This section discusses the current state of information about bilge water, the laws regulating bilge water discharges from vessels, the types of equipment used to treat bilge water generated on cruise ships, the potential environmental impacts of cruise ship bilge water, and federal actions taken to address bilge water from cruise ships.

4.1 What is bilge water and how much is generated on cruise ships?

Bilge water is the mixture of water, oily fluids, lubricants, cleaning fluids, and other similar wastes that accumulate in the lowest part of a vessel from a variety of different sources including the engines (and other parts of the propulsion system), piping, and other mechanical and operational sources. It is not uncommon on ships for oil to leak into the bilge from engine and machinery spaces or from fittings and engine maintenance activities. These leaks, along with onboard spills, wash waters generated during the daily operation of a vessel, and waste water from operational sources (e.g., water lubricated shaft seals, propulsion system cooling, evaporators, and other machinery), collect in the bilge. In addition to containing oil and grease, bilge water may contain solid wastes such as rags, metal shavings, paint, glass, and a variety of chemical substances (EPA, 1997). Bilge water may contain various oxygen-demanding substances, volatile organic compounds, semi-volatile organics, inorganic salts, and metals. Bilge water also may contain other contaminants such as soaps, detergents, dispersants, and degreasers used to clean the engine room. These cleaning agents create an emulsion and prevent separation of oil and water. Moreover, they are often incompatible with Oily Water Separators and Oil Content Monitors. Due to the various sources that contribute to the production of bilge water, the composition of bilge water varies from vessel to vessel, and from day to day. Other waste streams discussed in this report, such as graywater and sewage, are typically contained within their own systems and might only be present in bilge water as a result of leaks.

The amount of bilge water that accumulates on board can vary, and depends on a number of factors including the size of the ship, engine room design, preventative maintenance, and the age of the components. Accumulation of bilge water is ongoing and needs to be properly managed because it can cause damage to the propulsion systems and ancillary machinery on the vessel as well as present a fire hazard and impact the vessel's stability. Periodically, it is necessary to pump out the bilge spaces into a holding tank, which allows the vessel to maintain stability and eliminates potentially hazardous conditions from the accumulation of bilge water.

Large vessels such as cruise ships have several additional waste streams that contain sludge, waste oil, and oily water mixtures, including fuel oil sludge, lubricating waste oil, and cylinder oil, that can inadvertently find their way to the bilge. Sludge is produced by the constant purification of fuel. To prevent damage to the ship's engines, the fuel is purified by centrifuges virtually continuously. Oil purifiers remove the waste which typically drains into a sludge tank. Lubricating oil needed for the ship's engines are processed in the same fashion. Cylinder oil comes from the oil injected along the cylinder walls in the engine and contains contaminants from the combustion process. All of these waste oils are typically drained to a sludge tank. The production of sludge, unlike bilge water, remains fairly constant and is usually at least 1-2 percent of the heavy fuel oil consumed on board. Among the impurities separated out by the purifiers are water and oily water.

There are various management practices that can lead to cross contamination of the bilge water from the sludge tank. For example, if the same pumps and manifolds are used for transfers, it may leave residual sludge and oil in the pipes used for the bilge system. Also, if the oily water from the sludge tank is removed and decanted to the bilge water holding tank, it may also bring with it greater concentrations of oil.

ADEC (2000) reported that cruise ships operating in Southeast Alaska produced 1,300 to 5,300 gallons of oily bilge water every 24 hours. Table 4-1 shows the bilge water production and treatment capacities based on ship tonnage.

Table 4-1. Maximum Daily Volume of Bilge Water Production

Ship Tonnage (Gross Tons)	Passenger and Crew Capacity	Bilge Water Production (max. gallons/day)	Bilge Water Treatment Capacity (max. gallons/day)
22,000	1,100	1,000	5,000
46,000-48,000	1,500-2,160	3,000	4,000
50,700-55,400	1,850-2,380	5,000	5,000
76,000-78,000	2,700-3,200	2,640	6,400

Source: ADEC, 2000

4.2 What laws apply to bilge water from cruise ships?

4.2.1 International Convention for the Prevention of Pollution from Ships and Act to Prevent Pollution from Ships

The International Convention for the Prevention of Pollution from Ships (MARPOL)
The International Convention for the Prevention of Pollution from Ships, 1973, and Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, together are referred to as MARPOL or the MARPOL Protocol. Six Annexes of the Convention cover various sources of pollution from ships and provide a framework for international objectives. However, these Annexes are only in force if ratified and implemented by the flag state. The vast majority of cruise lines operating in United States ports are foreign flag vessels. Cruise ships flagged under countries that are signatories to MARPOL are subject to its requirements,

regardless of where they sail, and member nations are responsible for vessels registered under their respective nationalities.

MARPOL Annex I, *Regulations for the Prevention of Pollution by Oil*, addresses oil pollution and lists oil prevention requirements for machinery spaces on all ships covered by the Convention and provides requirements for cargo areas of oil tankers. The requirements of MARPOL Annex I cover all petroleum products, including crude oil, fuel oil, oily waste, oily mixtures located in the bilge, and petroleum products in cargo spaces of oil tankers. In 1983, the United States ratified Annex I of the International Convention for the Prevention of Pollution from Ships (MARPOL).

The Act to Prevent Pollution from Ships (APPS)

The Act to Prevent Pollution from Ships (APPS; 33 U.S.C. § 1901 et seq.) is the federal law implementing those provisions of MARPOL that have been ratified by the United States. With respect to implementation of Annex I, APPS applies to all U.S. flagged ships anywhere in the world, and to all foreign flagged vessels operating in the navigable waters of the United States (which extend seaward 3 nautical miles from shore for the purpose of this statute), or while at a port or terminal under the jurisdiction of the United States.

Applicable Coast Guard regulations

The Coast Guard generally has the primary responsibility to prescribe and enforce the regulations necessary to implement APPS in the United States. Because most cruise lines are foreign registered and because APPS only applies to foreign ships within the navigable waters, the APPS discharge regulations have limited applicability to cruise ship operations, especially since U.S. enforcement practices have led most cruise lines to implement policies restricting discharges of machinery space waste within three miles. However, the following Coast Guard regulations pertain to ship discharges of oil or oily mixtures into the sea[1]:

- Coast Guard regulations (33 CFR 151.10) provide that, when within 12 nautical miles of the nearest land, any discharge of oil or oily mixtures into the sea from a ship is prohibited except when all of the following conditions are satisfied:
    - (1) The oil or oily mixture does not originate from cargo pump room bilges;
    - (2) The oil or oily mixture is not mixed with oil cargo residues;
    - (3) The oil content of the effluent without dilution does not exceed 15 parts per million (ppm);
    - (4) The ship has in operation oily-water separating equipment, a bilge monitor, bilge alarm, or combination thereof, as required by Part 155 Subpart B; and
    - (5) The oily-water separating equipment is equipped with a 15 ppm bilge alarm; for U.S. inspected ships, approved under 46 CFR 162.050 and for U.S. uninspected ships and foreign ships, either approved under 46 CFR 162.050 or listed in the current International Maritime Organization (IMO) Marine

[1] Sections 151.09 through 151.25 of the Coast Guard regulations at Chapter 33 CFR do not apply to: 1) A warship, naval auxiliary, or other ship owned or operated by a country when engaged in noncommercial service; 2) A Canadian or U.S. ship being operated exclusively on the Great Lakes of North America or their connecting and tributary waters; and 3) A Canadian or U.S. ship being operated exclusively on the internal waters of the United States and Canada; or 4) Any other ship specifically excluded by MARPOL 73/78.

Environment Protection Committee (MEPC) Circular summary of MARPOL 73/78 approved equipment.

- Coast Guard regulations (33 CFR 151.10) provide that, when more than 12 nautical miles from the nearest land, any discharge of oil or oily mixtures into the sea from a ship is prohibited except when all of the following conditions are satisfied:
  (1) The oil or oily mixture does not originate from cargo pump room bilges;
  (2) The oil or oily mixture is not mixed with oil cargo residues;
  (3) The ship is not within a special area;
  (4) The ship is proceeding en route;
  (5) The oil content of the effluent without dilution is less than 15 ppm; and
  (6) The ship has in operation oily-water separating equipment, a bilge monitor, bilge alarm, or combination thereof, as required by Part 155 Subpart B.

  Further, Coast Guard regulations (33 CFR 151.10) provide that if the bilge water cannot be discharged in compliance with these standards, then it must be retained onboard or discharged to a designated reception facility. However, both MARPOL and the APPS regulations exempt emergency discharges needed to save the ship or save a life at sea. Emergency discharges or other exceptional discharges must nevertheless be accurately recorded in ship records and reported to the nearest port state or Coast Guard Captain of the port.

- In addition, Coast Guard regulations (33 CFR 151.25) provide that vessels of 400 gross tons and above shall fully maintain an Oil Record Book Part I (Machinery Space Operations) and vessels of 150 gross tons and above that carry 200 cubic meters or more of oil in bulk shall also maintain an Oil Record Book Part II (Cargo/Ballast Operations). The Oil Record Book is subject to routine inspection by the Coast Guard. (33 C.F.R. 151.23; 151.25(g)). In pertinent part, the APPS regulations require:

  (a) Each oil tanker of 150 gross tons and above, ship of 400 gross tons and above other than an oil tanker, and manned fixed or floating drilling rig or other platform shall maintain an Oil Record Book Part I (Machinery Space Operations). An oil tanker of 150 gross tons and above or a non oil tanker that carries 200 cubic meters or more of oil in bulk, shall also maintain an Oil Record Book Part II (Cargo/Ballast Operations).

  * * *

  (d) Entries shall be made in the Oil Record Book on each occasion, on a tank to tank basis if appropriate, whenever any of the following machinery space operations take place on any ship to which this section applies--
  (1) Ballasting or cleaning of fuel oil tanks;
  (2) Discharge of ballast containing an oily mixture or cleaning water from fuel oil tanks;
  (3) Disposal of oil residue; and
  (4) Discharge overboard or disposal otherwise of bilge water that has accumulated in machinery spaces.

  * * *

(g) In the event of an emergency, accidental or other exceptional discharge of oil or oily mixture, a statement shall be made in the Oil Record Book of the circumstances of, and the reasons for, the discharge.

(h) Each operation described in paragraphs (d), (e) and (f) of this section shall be fully recorded without delay in the Oil Record Book so that all the entries in the book appropriate to that operation are completed. Each completed operation shall be signed by the person or persons in charge of the operations concerned and each completed page shall be signed by the master or other person having charge of the ship.

(i) The Oil Record Book shall be kept in such a place as to be readily available for inspection at all reasonable times and shall be kept on board the ship.

(j) The master or other person having charge of a ship required to keep an Oil Record Book shall be responsible for the maintenance of such record.

MARPOL contains additional requirements on what information must be recorded in an Oil Record Book, including the details of overboard discharges of "bilge water which has accumulated in machinery spaces"[2] (MARPOL, Annex I, Appendix III(D)). MARPOL also requires the logging of any failure of the oil discharge monitoring and control equipment (Id. at Appendix III(F)). MARPOL also requires that any accidental or other "exceptional" discharge be recorded in the Oil Record Book (Id. at Appendix III(G)). In short, cruise ships visiting United States ports must maintain an accurate record of overboard discharges per this requirement.

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[2] The MARPOL Protocol, Annex I, Appendix III, in pertinent part requires logging of the following information:

(D) Non-automatic discharge overboard or disposal otherwise of bilge water which has accumulated in machinery spaces

13. Quantity discharged or disposed of.
14. Time of discharge or disposal (start and stop).
15. Method of discharge or disposal:
    .1 through 15 ppm equipment (state position at start and end);
    .2 to reception facilities (identify port);
    .3 transfer to slop tank or holding tank (indicate tank(s); state quantity transferred and the total quantity retained in tank(s).

* * *

(F) Condition of oil discharge monitoring and control system

20. Time of system failure.
21. Time when system has been made operational.
22. Reasons for failure.

* * *

(G) Accidental or other exceptional discharges of oil

23. Time of occurrence.
24. Place or position of ship at time of occurrence.
25. Approximate quantity and type of oil.
25. Circumstances of discharge or escape, the reasons therefore and general remarks.

4.2.2 Oil Pollution Act and Clean Water Act

The Oil Pollution Act of 1990 (OPA; 33 U.S.C. § 2701 et seq.) is a comprehensive statute designed to expand oil spill prevention, preparedness, and response capabilities of the federal government and industry. It amends section 311 of the Clean Water Act (CWA; 33 U.S.C. § 1321) to clarify federal response authority, increase penalties for spills, establish Coast Guard response organizations (including elements of the National Strike Force, district response advisory staff, Coast Guard personnel, and equipment of ports within the district), require tank vessel and facility response plans, and provide for contingency planning in designated areas. CWA section 311, as amended by the Oil Pollution Act of 1990, applies to cruise ships and prohibits discharge of oil or hazardous substances in harmful quantities into or upon U.S. navigable waters, or into or upon the waters of the contiguous zone, or which may affect natural resources in the U.S. Exclusive Economic Zone (which extends 200 miles offshore).

EPA regulations (40 CFR 110.3) provide that for the purposes of section 311(b)(4) of the CWA, discharges of oil in quantities that the Administrator has determined may be harmful to the public health or welfare or the environment of the United States include discharges of oil that:

- violate applicable water quality standards, or
- cause a film or sheen upon or discoloration of the surface of the water or adjoining shorelines, or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines.

4.3 How do cruise ships manage bilge water?

In order to maintain vessel stability and eliminate potentially hazardous conditions from the accumulation of bilge waste, it is necessary to periodically pump out the bilge spaces into a holding tank. The bilge water then can be managed in one of two ways: (1) retained onboard in a holding tank and discharged later to a reception facility on shore; or (2) treated onboard with an Oily Water Separator (OWS). The treated bilge water then can be discharged overboard in accordance with applicable standards and regulations while the petroleum products extracted by the OWS (i.e., oily waste) are retained in a dedicated holding tank onboard (and later could be incinerated and/or offloaded in port). The international standard established by MARPOL Annex I, and implemented into United States law by APPS, is that machinery space waste including bilge water may be discharged overboard if it contains a concentration of 15 ppm oil or less. MARPOL and APPS also require that the discharge be made through 15 ppm equipment, namely an OWS and Oil Content Monitor.

The holding tank may contain other oily water mixtures including those resulting from the purification of fuel and lubricating oils. In addition to removing the waste from the bilge area, a holding tank can allow for some separation of the oil and water. Bilge water may be discharged overboard after processing by an Oily Water Separator and passing through a bilge alarm, more commonly known as an Oil Content Monitor that is designed to detect when the effluent exceeds an oil content of greater than 15 ppm. The required pollution prevention equipment also includes an automatic stopping device (typically a three-way solenoid valve) that when triggered by the

Oil Content Monitor, will automatically divert the oily water mixture back into a holding tank. APPS and MARPOL define machinery space waste as an oily water mixture.

All ships over 400 gross tons are required to have equipment installed onboard that limits the discharge of oil into the oceans to 15 ppm when a ship is en route and provided the ship is not in a special area (where all discharge of oil is prohibited). Such ship equipment allows for compliance with both international regulations (MARPOL) and Coast Guard regulations that require the oil content of the discharged effluent to be less than 15 ppm and that it not leave a visible sheen on the surface of the water. Regulations also require that all oil or oil residues that cannot be discharged in compliance with these regulations, be retained onboard or discharged to a reception facility.

Conventional bilge water systems use an OWS to remove oil to meet regulatory standards prior to discharge. These systems use the techniques of centrifugal force, coalescence, gravity, and other methods to isolate oil from water (Table 4-2 describes some OWS technologies). The management of bilge water by most vessels consists of the following steps:

1) Bilge water is pumped into a holding tank, which is usually of sufficient size to hold the water for several days;
2) Bilge water is processed by an OWS to extract oil and petroleum products from the bilge water. Different cruise ships may use different types of OWS (e.g., centrifugal, filtration, and gravity based systems);
3) The treated bilge water from the OWS is discharged overboard provided that the OWS is certified by the Coast Guard, using International Standards Organization 9377-2:2000; the discharge does not have an oil content of greater than 15 ppm; and the discharge does not leave a visible sheen on the surface of the water;
4) All oil or oil residues that cannot be discharged in compliance with the abovementioned requirements – generally the oily waste collected by the OWS – is retained in a holding tank until it can be incinerated onboard or offloaded to a land-based treatment facility (CELB, 2003).

Table 4-2. Oily Water Separator Technologies

Description/Capabilities of OWS Devices	Processing Capacity
– Removes oil and grease using naturally-occurring bacteria – Continuous monitoring of hydrocarbons in effluent	Up to 20,000 gallons of bilge water per week (2,880 gal/day)
– Designed to separate and to remove free and emulsified oil – System can treat bilge and sludge – Oil content meter (bilge alarm calibrated to measure 15 ppm oil content)	12 - 24 m^3/day (or 53 - 106 gal/day)
– Utilizes fluid velocity reduction, differential specific gravity, and coalescences to separate nonsoluble oil, solids, and entrained air from oily water – Provides efficient removal or reduction of oil content to 15 ppm or less	Up to 44 gallons per minute
– High-speed centrifugal separation system for treatment of large bilge water volumes at sea – Generally reduces oil content to below 5 ppm – Continuous operation (24 hours/day)	Approximately 400 - 1320 gallons per hour

Sources: Ensolve, 2006; Senitec, 2007; Coffin World Water Systems, 2006; Alfa Laval, 2006

All vessels are required to have a bilge alarm or bilge monitor integrated into the piping system to detect whether the treated bilge water that is being discharged from the oily water separator has turbidity levels calibrated to be equivalent to samples containing an oil content greater than 15 ppm. If the monitor senses that the oil in the bilge water exceeds 15 ppm, the system is required to stop the overboard discharge and divert the effluent back to a holding tank. Any bilge water found to contain oil or oil residues with an oil content greater than threshold levels must be retained onboard or discharged to a designated reception facility. According to CELB (2003), several cruise lines now often use two oily water separators to assure that effluent levels meet or exceed the 15 ppm limit.

Cruise Lines International Association (CLIA) member lines have agreed to incorporate various standards for waste stream management into their Safety Management Systems (see Section 1.3). For bilge water and oily water residues, CLIA member lines have agreed to meet or exceed the international requirements for removing oil from bilge and wastewater prior to discharge. More specifically, CLIA member lines have agreed that bilge and oily water residue are processed prior to discharge to remove oil residues, such that oil content of the effluent is less than 15 ppm as specified by MARPOL Annex I.

In accordance with MARPOL (73/78) Regulation 20 and U.S. regulations (33 CFR 151.25) as appropriate, CLIA member lines have agreed that every cruise ship of 400 gross tons and above shall be provided with an oil record book which shall be completed on each occasion whenever any of numerous specified operations take place on the ship. Those operations include the following (CLIA, 2006):

a. Ballasting or cleaning of fuel oil tanks;
b. Discharge of dirty ballast or cleaning water form the fuel oil tanks above;
c. Disposal of oily residues; and
d. Discharge of bilge water that accumulated in machinery spaces.

4.4 What are the potential environmental impacts associated with inadequately treated bilge water from cruise ships?

Cruise ships have the potential to discharge oil or oily water via inadequately separated oily bilge water as a result of a faulty or malfunctioning OWS, human error, malfunctioning bilge monitors, or a deliberate OWS by-pass. Exposure of marine organisms to petroleum hydrocarbons can result in mortality due to acute toxicity or physical smothering. Additionally, possible long-term impacts include: impaired survival or reproduction; chronic toxicity of persistent components; and habitat degradation (Peterson and Holland-Bartels, 2002). Oil, even in minute concentrations, can kill fish or have various sub-lethal chronic effect (CRS, 2007), as well as severely damage coral reefs. According to the Bluewater Network (2000), ingestion of oil can kill birds or lead to starvation, disease, and predation of these animals. A Canadian study has estimated that 300,000 seabirds are killed annually in Atlantic Canada from this type of routine discharge of oily vessel waste (Wiese and Robertson, 2004).

According to CELB (2003), any oils that remain on the surface can interfere with larvae development and marine birds; heavier oils can sink to the bottom of the ocean and contaminate

the sediment, causing potential long-term impacts to benthic habitats. According to CELB (2003), diesel fuel is acutely toxic to fish, invertebrates, and seaweed, although in open water this fuel dilutes quite rapidly. CELB (2003) further states that spills can be particularly toxic to crabs and shellfish in shallow, confined near-shore areas because in these organisms oil bio-accumulates – often over a period of several weeks after exposure.

4.5 What action is the federal government taking to address bilge water from cruise ships?

EPA is developing a water permit program for pollutant discharges incidental to the normal operation of vessels. Under a recent court decision, the existing EPA regulations that exclude discharges incidental to the normal operation of a vessel from Clean Water Act permitting will be vacated (revoked) as of September 30, 2008. The Agency is appealing that decision, but if left unchanged, this would mean that vessel owners or operators whose discharges previously have been excluded from such permitting by the regulation will require a permit beginning September 30, 2008. Such regulated discharges may include bilge water. At the time this report went to press, EPA was in the process of developing a permitting framework.

The federal government's bilge water management efforts have focused on responding to oil spills and developing preventative programs. The Coast Guard is the primary federal agency responsible for monitoring and enforcing cruise ship discharges. In addition to monitoring and enforcing standards, the Coast Guard has been working with the IMO to develop new international performance standards for oil pollution prevention equipment.

The Coast Guard has a robust enforcement regime involving all vessels regarding violations of MARPOL Annex I. The Coast Guard conducts inspections of all cruise vessels operating in United States ports and waters quarterly and annually. These inspections typically include examination and testing of pollution prevention equipment and review of Oil Record Books. The Coast Guard works closely with the U.S. Department of Justice (DOJ). Through this cooperation, criminal enforcement actions have been taken for intentional discharges of oily bilge waste. The most common violations of bilge water quality and treatment requirements include the intentional falsification of Oil Record Books to conceal the deliberate bypassing of the OWS entirely or tampering with the monitoring equipment. Tampering has included disabling or modifying the Oil Content Monitor or flushing the device with freshwater to prevent sampling of the actual effluent. Inspections of vessels have found the following problems:

- Data records that are manipulated or data recorders that are disabled;
- Poorly maintained OWS equipment and related piping systems;
- Crew error or lack of crew training;
- Bilge alarms/monitors that are out of calibration due to poor maintenance (thereby allowing bilge water discharges that exceed 15 ppm of oil);
- Piping systems that are re-routed to bypass the bilge alarms/monitors; and,
- Improper use of oil inhibitors to degrade OWS efficiency and to conceal oil discharge sheens.

Additionally, deliberate discharges of untreated bilge water might be accompanied by efforts to deceive port state control officials by falsifying the Oil Record Book. Several port states (i.e., the country the cruise ship visits) have reacted by increasing their scrutiny of OWS systems and diligence for oil record book keeping (OECD, 2003). The U.S. is taking a lead in enforcement actions for such criminal violations. To date the U.S. has prosecuted over 75 cases involving intentional discharges of oily bilge waste from vessels in general, with over $150 million collected in criminal fines since 2000. Many of the major cruise ship companies calling on U.S. ports have been convicted of such violations, including, Royal Caribbean, Holland America, Carnival and Norwegian Cruise Line Limited. As a result of the prosecutions, all the companies have been at one time placed in probation with a requirement to implement Environmental Compliance Plans.

References

Alaska Department of Environmental Conservation (ADEC). 2000. *Alaska Cruise Ship Initiative Part 1 Final Report*. Juneau, AK. (www.dec.state.ak.us/water/cruise_ships/pdfs/finreportp10808.pdf)

Bluewater Network. (2000, March 17). Petition to Environmental Protection Agency Administrator Carol M. Browner. (www.epa.gov/owow/oceans/cruise_ships/petition.pdf)

Center for Environmental Leadership in Business (CELB). 2003. *A Shifting Tide: Environmental Challenges and Cruise Industry Responses.* Washington, DC. (www.celb.org/ImageCache/CELB/content/travel_2dleisure/cruise_5finterim_5fsummary_2epdf/v1/cruise_5finterim_5fsummary.pdf)

Congressional Research Service (CRS). 2007. *Cruise Ship Pollution: Background, Laws and Regulations, and Key Issues* (Order Code RL32450). Washington, DC. (www.ncseonline.org/NLE/CRSreports/07Jul/RL32450.pdf)

Cruise Line International Association (CLIA). 2006. *CLIA Industry Standard: Cruise Industry Waste Management Practices and Procedures*. Fort Lauderdale, FL. (www.cruising.org/industry/PDF/CLIAWasteManagementAttachment.pdf and www.cruising.org/industry/PDF/CLIAWasteManagement.pdf)

Organization for Economic Co-operation and Development (OECD). 2003. *Cost Savings Stemming from Non-Compliance with International Environmental Regulations in the Maritime Sector*. Paris, France. (www.oecd.org/dataoecd/4/26/2496757.pdf)

Peterson, Charles H. et al. 2002. Nearshore vertebrate predators: constraints to recovery from oil pollution. *Marine Ecology Progress Series* 241:235-236.

U.S. Environmental Protection Agency. 1997. *Profile of the Water Transportation Industry*. (EPA/310-R-97-003). Washington, D.C.: Author. (http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/watersct.pdf)

Wiese, F.K. & Robertson, G.J. 2004. Assessing impacts of chronic oil discharges at sea on seabirds: a general oiled seabird mortality model applied to Eastern Canada. *Journal of Wildlife Management* 68: 627–638.